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DEPARTMENT OF AGRICULTURE

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A difference between any two treatments greater than the figure given as "Significant difference" is due to the particular treatment. The proof is not absolute but unless otherwise stated the figure for significant difference is at the level of probability $P = 0{\cdot}05$, which means that the chances against drawing a wrong conclusion by using the significant difference figure is nineteen to one. If the significant difference is based on $P = 0{\cdot}01$ then the chances are ninety-nine to one against the conclusion being wrong.

Where no figure for significant difference is given the differences that occur cannot be considered as being due to the particular treatment.

I wish to record my thanks to Mr. C. R. Devonshire, Liquorer to the Kenya Coffee Board, for liquoring the many coffee samples sent to him, and also to Mr. Robinson, Statistician, East African Agricultural and Forestry Research Organization, for his advice on the analysis of the various experiments.

I wish also to express my appreciation of the work done by the Staff of this Station.

Coffee Research Station,
Lyamungu, Moshi,
8th February, 1950

F. R. SANDERS,
Senior Research Officer

COFFEE RESEARCH AND EXPERIMENTAL STATION, LYAMUNGU, MOSHI

Report for the Period 1st January to 31st December, 1948

STATION DEVELOPMENT

Statement of Acreages.—No new plantings of coffee were made during the year. The area under fodder grasses was decreased.

	Acres	Change
Coffee :—		
(a) under 4 years ... ... 3·88		
(b) 4 to 6 years ... ... 8·73	86·16	
(c) over 6 years ... ... 73·55		
Nurseries and propagation beds	2·50	
Bananas and fodder grasses	46·14	−1·86
Paddocks	30·00	
Coppices and wind belts	35·00	
In preparation for experiments	10·46	+2·46
Forest	23·40	
Roads, buildings, etc.	28·00	
Bush—cleared and uncleared	42·44	−0·60
Food crops for labourers	5·90	
Total ...	310·00	

Buildings.—The building of the new general store was completed.

The Public Works Department commenced building eight new Recorders quarters and installing a hydraulic ram for the domestic and laboratory water supply.

A new set of storage batteries was installed.

Lyamungu Coffee Estate.—A portion of this estate adjoining the station is to be used as an extension; this was leased from the Custodian of Enemy Property as from 1st February, 1948. Some seven acres contiguous with the old northern boundary of the station, which had previously been used for labourers huts and gardens, were cleared and cultivated. This land was found to be heavily infested with couch grass (*Digitaria scalarum*), in parts down to a depth of three feet, and the cost of eradication was approximately £15 per acre.

Large areas of unthrifty coffee which had been deep planted were uprooted. The uprooting of part of the dense stand of trees (mostly unsuitable as shade trees and useless for timber) was started. Some two and a half miles of road on the estate were constructed or repaired.

Work was commenced on renovating some thirty-one acres of mature coffee, the only coffee on the estate which had not been deep-planted. The trees were severely pruned to reduce the umbrella-effect of the top-most primaries and thus save the lower primaries, which were rapidly dying off. The dense growth of shade trees was considerably lightened, and a start was made in eradicating some bad patches of couch grass (*Digitaria scalarum*) and *Kyllinga controversa*. It was too late in the season to hope for a crop in 1948 or 1949, and these operations were deliberately directed towards the 1950 crop.

METEOROLOGY

It was generally a year of light rainfall, only 49·50 inches being recorded. This was less than the total for the two months April and May in the previous year. The short rains, however, were good, 6·19 inches being recorded in December. This brought out a heavy flowering at Christmas.

The monthly rainfall for 1948 is given below :—

	Inches		Inches
January	0·46	July	1·53
February	0·71	August	0·44
March	2·72	September	0·30
April	14·50	October	2·51
May	15·56	November	1·65
June	2·93	December	6·19
		Total ...	49·50

The monthly rainfall for the period September 1937 to August 1948 is given in Appendix I.

PESTS AND DISEASES

Spraying with a 0·1 per cent solution of D.D.T. emulsion at the rate of eighty gallons per acre was carried out as a routine measure against Antestia when testing indicated the necessity for control measures. D.D.T. was also used successfully against Thrips at the beginning of the year. The addition of the D.D.T. emulsion to Bordeaux Mixture proved effective as a dual purpose spray against Antestia and Hemileia leaf disease respectively.

LABOUR

Labour was generally plentiful throughout the year, though some falling-off occurred during the last quarter when it was most needed for picking.

THE 1948 CROP

1948 was the "off" year in the general biennial bearing sequence on Kilimanjaro. After the heavy crop in 1947, it was only to be expected that a smaller crop would result. Nevertheless, some twenty-five tons of parchment coffee were sent to the mills. It is gratifying to record that nearly three tons of parchment were classified as Class I, while Class II was awarded to eighty-seven per cent of the remainder of the main season pickings.

The number of plot and tree samples from experiments for analysis was greatly increased, a total of 3,410 samples being taken for the season. From these, data in respect of grade, out-turn(*), bean weight and specific gravity were recorded, while other samples were submitted to the Liquoring Department of the Kenya Coffee Marketing Board for liquoring reports.

(*) It has been found necessary to obtain actual out-turn figures (clean to cherry) from all pickings from all experimental plots in each year in order to obtain the yield correctly. The out-turn varies with the pickings in any one season, the early and late pickings usually have a lower out-turn than the main pickings, there is also some variation from treatment to treatment in an experiment and also from season to season. Taking an arbitrary figure of sixteen per cent which is the usual figure taken, very misleading results can be obtained.

ARUSHA AGRICULTURAL SHOW

The station was awarded a first prize for an exhibit staged at the Arusha Agricultural Show in November. Experimental results and other activities were demonstrated.

MBOSI SUB-STATION

The Selection Trials planted in 1947 made good growth. The guard rows consisting of mature seedling material of F.840 or F.839 yielded well. This selection seems suited to the Mbosi conditions.

Arrangements were made for the acquisition of additional land adjacent to the sub-station and development was commenced. The new area will be used for additional experiments and the production of mulching material.

Preliminary investigations into suspected boron deficiency were undertaken.

ANIMAL HUSBANDRY

There were twenty-six cows in milk during the year, yielding an average of 212·1 gallons per cow. The average yield per cow in herd No. 1 was 249·8 gallons and that in herd No. II was 196·0 gallons. The highest lactation over 305 days was 446·6 gallons given by Kaya (herd No. I) in her seventh lactation. This is the highest yield on record at this station beating the same cow's previous record by 31·1 gallons in her fifth lactation.

The first daughter of the Sahiwal-Boran bull cross calved down and gave 120·7 gallons of milk in the first seventy-six days (up to 31/12/48); this is an average of 16·4 lb. per day.

Twenty calves were born during 1948, eleven being heifers. Six heifers and four bulls were sold; one bull calf was slaughtered. The Baraton bull (C.R.S.I.) was returned to Kenya and two new bulls (one only a calf) were received in exchange. The older one was used immediately.

There were three cases of trypanosomiasis, from which one cow died. Three cows were treated by the Veterinary Officer for vaginitis, and two of these later held to the bull; the third is suspected of being barren.

Four small silage pits were dug and filled towards the end of the rains with excess herbage from the pastures and with elephant grass, molasses being added. Some coffee pulp was also ensiled.

Attempts were made to feed coffee pulp, both fresh and dried, to the herd, but were generally a failure. When mixed with the concentrates some of the dried pulp was eaten but was not relished.

The number of stock at the end of the year was as follows :—

Stud bulls	3
Cows, in-calf heifers, and yearlings	61
Bull calves	8
Total ...	**72**

SECTION II—IMPROVEMENT OF PLANT MATERIAL

Selection

Since the beginning of the war, the search for high-yielding trees has been confined to seedling trees established on the Station. In one block of Kents, where 586 trees were originally recorded, the number recorded was reduced to thirty-nine trees after five years. Table I shows the yields (expressed as cwts. of clean coffee per acre) of these trees, year by year, over the past eleven years. The extreme variability even of these potential selections is most marked, the mean yields ranging from 6·50 to 14·35 cwts. of clean coffee per acre. The recording, at least of the most promising ones, will be continued as long as possible, so that subsequent behaviour may be observed. The trees have all been pruned on the single stem system.

TABLE I—Kents Plot Selections

T = Trace.

Yields calculated as cwts. of clean coffee per acre

Year	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Mean
Out-turn	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	Actual	
Tree No. :												
KP. 146	25·14	15·36	31·23	7·98	12·90	12·05	17·06	3·82	1·70	11·63	15·31	14·02
,, 147	28·17	3·75	8·23	11·29	1·53	10·78	7·72	12·90	T	6·45	1·26	8·37
,, 151	8·60	12·11	7·38	8·06	1.36	3·73	12·30	7·38	4·92	8·99	9·03	7·62
,, 154	12·71	17·74	9·33	13.75	0·59	12·30	2·38	11·46	1·10	22·15	30·56	12·19
,, 162	10·95	24·66	20·03	0·68	16.12	STUMPED			0·17	0·08	2·38	4·79	7·26
,, 163	19·43	22·34	10·95	5·77	13.58	13·24	17·06	3·31	3·82	16·80	13·56	12·71
,, 164	9·20	12·28	6·45	5·77	5·01	5·52	17·65	3·22	8·32	25·88	31·04	11·85
,, 176	9·33	12·33	15·95	9·08	0·59	2·21	8·74	0·17	4·33	9·08	4·66	6·95
,, 204	8·01	14·70	7·81	16·12	1·78	10·78	10·95	10·01	14·68	18·24	3·71	10·62
,, 214	6·79	28·17	1·27	11·63	6·36	5·86	5·60	—	0·59	5·18	—	6·50
,, 215	3·25	30·35	8·66	6·11	5·09	13·15	28·43	6·28	14·68	21·81	4·78	12·96
,, 218	8·26	27·05	6·87	1·78	3·82	9·08	13·24	3·31	8·49	13·24	3·91	9·00
,, 226	7·10	27·43	6·19	10·95	—	6·70	6·79	1·78	3·56	4·67	7·86	7·55
,, 227	11·90	22·49	16·29	17·48	0·93	12·81	12·64	T	4·92	16·55	0·29	10·57
,, 228	13·39	25·35	7·81	8·15	0·85	8·74	7·72	5·69	6·19	13·49	1·70	9·01
,, 231	14·37	16·86	25·20	1·02	3·31	11·37	19·26	4·58	5·60	17·23	14·29	12·10
,, 260	7·84	12·87	8·32	11·96	2·80	10·52	12·64	11·71	9·25	22·83	1·60	10·21
,, 261	9·57	11·54	10·01	3·39	2·72	7·21	10·78	6·28	7·81	7·64	12·26	8·11
,, 262	11·20	14·43	12·13	11·63	0·42	20·79	7·64	15·10	10·61	16·97	1·78	11·15
,, 263	10·98	19·46	7·01	16·38	1·02	12·13	10·86	4·07	6·79	8·49	5·94	9·38
,, 265	13·10	14·62	9·33	9·33	3·31	19·86	13·92	7·64	18·16	14·60	20·13	13·09
,, 266	9·90	10·95	8.57	5·43	0·34	6·45	12·47	3·48	17·74	6·53	14·78	8·79
,, 281	8·25	12·24	7·72	0·08	0·76	11·80	15·19	0·93	4·92	2·72	6·92	6·50
,, 285	9·42	12·30	6·87	18·75	1·53	16·46	15·10	3·14	14·51	9·50	12·39	10·91
,, 289	8·35	11·83	10·10	13·41	0·17	13·58	13·15	3·48	7·64	21·38	2·68	9·62
,, 352	9·05	22.01	0·68	14.17	—	11·63	6·96	4·92	6·02	11·12	18·05	9·51
,, 362	7·41	13·10	11·12	19·52	3·73	15·78	3·90	11·29	3·65	15·02	22·79	11·57
,, 405	6·74	14·70	2·46	2·80	2·72	12·13	15·02	5·26	10·10	17·23	28·80	10·72
,, 406	9·62	10·93	9·33	4·16	4·33	14·93	14·09	6·87	10·78	11·37	28·49	11·35
,, 409	9·88	13·88	5·35	9·25	3·99	18·16	10·44	8·83	11·80	10·78	19·39	11·07
,, 412	10·01	13·69	7.64	13·58	2·80	9·84	7·89	8·57	2·63	12·81	12·61	9·28
,, 414	10.52	11·76	7·02	6·62	1·78	10·61	6·70	6·45	7·38	8·74	24·77	9·30
,, 423	10·49	14·15	10·95	17·99	5·94	29·62	3·99	20·03	7·55	29·02	8·16	14·35
,, 466	8·68	12·36	6·78	14·51	0·34	15·10	8·32	9·08	1·19	14·51	12·38	9·39
, 512	10·27	11·15	2·89	15·78	2·12	15·78	10·36	7·04	6·62	9·25	18·16	9·95
, 518	5·74	14·87	2·29	13·07	3·99	10·52	10·18	6·70	1·78	8·57	8·68	7·85
,, 532	8·51	12·51	9·50	19·52	3·14	13·92	11·96	1·10	4·75	15·53	20·47	10·99
,, 683	18·35	12·47	6·62	15·61	2·04	16·29	4·24	14·93	0·51	9·25	11·36	10·15
,, 685	11·56	12·83	6·11	11·96	0·85	12·98	6·53	15·95	3·39	15·02	10·63	9·80
VC. 276	7·41	14·19	14·85	6·70	8·32	8·83	9·08	4·07	9·59	7·13	16·62	9·71
,, 363	7·64	14·91	5·60	9·50	12·47	12·73	0·59	13·32	5·35	3·31	15·96	9·22
,, 364	6·93	14·90	8·40	8·49	13·49	6·28	0·34	14·09	6·02	7·89	21·91	9·89

Experiment I, which was designed to test the effect on subsequent growth of different methods of planting, had fulfilled its purpose by 1947 when ten years yields had been obtained. All recording in this experiment was by individual trees, so that it was possible to isolate a further series of selections. Eleven trees, out of the total of 903 were selected, and their yields are shown in Table 2. Recording of these eleven trees is being continued. They are seedlings of the Kents type, pruned on the single stem system, the seed having been obtained from trees on an estate on Kilimanjaro in 1934. Seedlings were selected for size in the nursery at the time of planting out in 1935.

Samples of coffee from these selections were submitted for report as to liquoring and were classified as follows :—

Tree No.	Classification	Tree No.	Classification
11	1	200	2
33	1	255	1
188	3	339	2 +
197	1		

The report on the sample from Tree No. 188 described it as "ragged Harar type and tainted". The taint may have arisen during preparation.

TABLE 2

Experiment I—Selections

Yields calculated as cwts. of clean coffee per acre

Tree No.	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Mean Cwt. per acre
	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	Actual	
11 ...	8·99	4·56	7·81	21·30	8·23	33·35	—	41·66	0·85	26·39	10·37	14·86
33 ...	4·41	13·85	3·56	22·15	6·53	25·71	—	54·05	—	29·11	43·09	18·41
55 ...	14·09	3·79	13·92	13·24	9·84	23·59	—	38·27	2·04	49·73	1·28	15·44
71 ...	14·17	1·64	10·61	21·55	16·63	23·93	1·19	44·89	0·51	42·26	1·15	16·23
179 ...	13·32	2·04	6·53	21·30	2·12	27·75	3·05	39·03	—	25·03	1·47	12·88
188 ...	15·51	—	10·27	15·02	11·96	17·14	1·27	44·21	0·59	45·06	5·71	15·16
197 ...	13·72	1·36	10·86	14·43	7·21	21·64	8·74	50·26	0·59	27·24	20·80	16·08
200 ...	13·88	0·08	9·25	13·41	12·98	26·98	—	45·40	—	38·36	3·39	14·88
255 ...	13·85	—	10·52	19·86	3·05	19·77	—	49·90	—	41·24	4·14	14·76
339 ...	16·97	0·17	13·24	7·81	11·96	27·83	—	42·85	1·95	34·54	17·35	15·88
448 ...	15·24	1·10	14·60	10·10	5·18	26·48	—	46·16	6·70	46·08	1·65	15·75

Experiment II.—Seedling Selection Trials

These trials are laid out in the form of four 6×6 latin squares, and two randomised blocks, each with nine selections repeated six times. The object of the experiment is to compare the yields of seedling progeny of potential selections under the conditions existing at this station. The area has high light shade of *Albizzia maranguensis*, *Cordia Holstii*, and *Leucæna glauca*.

The yearly yields, and means over the bearing period, are given below and are expressed as cwts. of clean coffee per acre. The calculated yields of the parent trees, from which the original seed was obtained, are also given as a matter of interest, together with the number of years for which each tree was recorded. No direct comparison between these latter is possible, however, except where they bear the same initial letter, since they originate from estates often in widely differing districts.

Samples of coffee from all these selections were submitted for liquoring reports and, with the exception of P. 147, N. 69, J. 104, R. 2, N. 106, R. 11, J. 49 and H. 133, which were placed in class 2, all were class 1.

Latin Square I.—Planted May, 1938—Single Stem

Summary of Results for 1941-1948

Yields calculated as cwts. of clean coffee per acre

Parent												
Mean Yield	No. of years recorded	Selection	1941	1942	1943	1944	1945	1946	1947	1948	Mean of 8 years 1941—48	
											Cwt.	Percentage
7·13	7	F 502	1·32	2·65	6·82	8·42	3·94	5·02	16·32	4·14	6·08	127·0
15·00	5	P 280	1·21	4·35	7·01	7·87	2·55	4·85	13·84	1·80	5·43	113·5
11·88	5	P 313	0·95	4·60	6·17	8·30	2·57	4·45	13·78	4·37	5·65	118·0
12·32	5	P 348	0·84	2·07	4·43	6·38	1·19	5·31	9·75	4·63	4·32	90·3
13·17	5	P 147	0·73	1·57	3·82	5·96	1·54	4·20	10·09	4·88	4·10	85·6
13·34	5	P 190	0·77	1·29	1·53	3·69	0·87	3·63	6·56	6·78	3·14	65·6
Mean			0·97	2·76	4·96	6·77	2·10	4·58	11·72	4·43	4·79	100·0
Standard error			—	0·29	0·33	0·42	0·38	0·51	0·73	0·70	0·23	4·8
Significant difference			—	1·55 (P=·001)	0·96 (P=·05)	1·24 (P=·05)	1·12 (P=·05)	—	2·17 (P=·05)	2·06 (P=·05)	0·68 (P=·05)	14·2

Latin Square II.—Planted October, 1938—Single Stem

Summary of Results for 1942-1948

Yields calculated as cwts. of clean coffee per acre

Parent		Selection	1942	1943	1944	1945	1946	1947	1948	Mean of 7 years 1942-48	
Mean Yield	No. of years recorded									Cwt.	Percentage
15·04	4	H 133	1·56	4·67	4·57	1·45	3·18	13·37	1·98	4·37	97·8
11·44	8	L 1	1·13	4·86	4·42	2·05	3·52	14·42	4·45	4·98	111·5
9·39	7	F 839	1·11	4·78	5·39	3·91	2·38	15·38	3·70	5·24	117·2
16·83	7	N 39	0·93	3·09	3·35	3·46	3·04	12·86	6·48	4·74	106·2
13·17	5	P 147	0·76	2·78	4·28	0·88	3·29	10·17	5·02	3·88	86·8
7·50	7	E 59	0·69	2·04	3·94	0·88	3·20	8·62	5·74	3·59	80·4
Mean			1·03	3·71	4·29	2·10	3·10	12·47	4·56	4·47	100·0
Standard error			0·27	0·37	0·24	0·33	0·44	0·69	0·73	0·18	4·0
Significant difference (P=·05)			—	1·08	0·70	0·99	—	2·02	2·22	0·52	11·7

Latin Square III.—Planted October, 1938—Single Stem

Summary of Results for 1942-1948

Yields calculated as cwts. of clean coffee per acre

Parent		Selection	1942	1943	1944	1945	1946	1947	1948	Mean of 7 years 1942-1948	
Mean Yield	No. of years recorded									Cwt.	Percentage
15·07	4	H 1	1·34	4·85	8·36	3·64	1·82	15·78	7·55	6·19	134·1
8·76	7	F 840	0·90	4·57	7·87	3·65	3·44	15·96	4·33	5·81	125·9
11·88	5	P 313	3·13	4·30	5·87	0·75	2·29	11·24	1·26	4·12	89·2
13·75	7	N 69	1·83	5·42	5·06	1·53	3·37	11·89	1·62	4·39	95·1
15·20	7	N 50	1·54	4·77	4·55	1·08	2·61	10·81	1·45	3·83	83·0
6·57	7	E 665	1·40	2·44	4·24	0·55	2·78	8·51	3·64	3·36	72·9
Mean			1·69	4·39	5·99	1·87	2·72	12·37	3·31	4·62	100·0
Standard error			0·26	0·33	0·44	0·37	0·45	1·07	0·45	0·26	5·6
Significant difference			1·39 (P=·001)	0·96 (P=·05)	1·30 (P=·05)	1·08 (P=·05)	—	3·14 (P=·05)	1·34 (P=·05)	0·77 (P=·05)	16·6

Latin Square IV.—Planted 1939—Single Stem

Summary of Results for 1942-1948

Yields calculated as cwts. of clean coffee per acre

Parent			1942	1943	1944	1945	1946	1947	1948	Mean of 7 years 1942-1948	
Mean Yield	No. of years recorded	Selection								Cwt.	Percentage
11·23	7	N 81	0·94	1·56	2·78	0·01	1·28	6·60	1·29	2·07	74·4
16·83	7	N 39	0·05	0·61	1·81	0·09	0·62	6·52	2·79	1·69	61·0
11·44	8	L 1	0·75	1·65	3·53	0·12	1·59	10·27	1·52	2·77	99·9
15·07	4	H 1	0·81	3·78	6·23	2·16	0·88	13·41	6·71	4·78	172·2
13·88	7	N 197	0·55	2·19	3·37	0·12	2·61	10·51	2·70	3·15	113·5
18·38	7	R 3	0·98	2·16	2·39	0·04	1·34	7·35	1·11	2·19	79·0
Mean			0·68	1·91	3·35	0·42	1·39	9·11	2·69	2·78	100·0
Standard error			0·08	0·17	0·25	—	0·26	0·71	0·62	0·18	6·5
Significant difference			0·44 (P=·001)	0·50 (P=·05)	0·74 (P=·05)	—	0·77 (P=·05)	2·10 (P=·05)	1·81 (P=·05)	0·53 (P=·05)	19·2

Randomized Block I.—Planted April, 1939—Single Stem

Summary of Results for 1942-1948 crop

Yields calculated as cwts. of clean coffee per acre

Parent		Selection	1942	1943	1944	1945	1946	1947	1948	Mean of 7 years 1942-1948	
Mean Yield	No. of years recorded									Cwt.	Percentage
11·71	7	R 11	0·83			1·95	1·17	9·65	2·07	2·43	79·4
14·02	7	R 2	0·65			1·68	1·32	9·51	3·09	2·50	81·9
14·49	4	H 61	0·72			5·94	1·21	13·93	8·99	4·64	151·8
Unrecorded		R.R.H.— vigorous	0·87	CROP FAILED	CROP FAILED	4·10	1·74	14·27	5·90	4·10	134·0
24·22	7	R 13	0·82			1·86	1·34	11·71	4·33	3·13	102·2
15·04	4	H 133	0·91			1·87	1·32	11·49	3·76	3·03	99·2
10·81	6	J 104	0·80			1·51	1·44	10·38	4·00	2·85	93·0
12·13	7	N 106	0·55			1·36	1·24	9·42	3·38	2·46	80·4
14·55	7	N 5	0·46			1·47	0·70	7·81	5·49	2·39	78·0
Mean			0·74			2·42	1·27	10·90	4·56	3·06	100·0
Standard error			0·12			0·41	0·21	0·71	0·78	0·15	4·9
Significant difference			0·21 (P=·2)			1·18 (P=·05)		2·03 (P=·05)	2·24 (P=·05)	0·43 (P=·05)	14·0

Randomized Block II.—Planted April, 1939—Single Stem

Summary of Results for 1942-1948 crop

Yields calculated as cwts. of clean coffee per acre

Parent		Selection	1942	1943	1944	1945	1946	1947	1948	Mean of 7 years 1942-1948	
Mean Yield	No. of years recorded									Cwt.	Percentage
13·58	7	N 100	1·27			0·55		10·11	1·50	2·43	108·0
13·59	7	N 217	1·58			0·59		9·38	1·74	2·31	102·5
13·93	7	R 1	1·13			0·48		9·15	2·11	2·36	105·0
12·63	7	N 229	0·89			0·35		7·79	1·51	1·98	87·8
15·19	7	N 34	1·24			0·45		9·33	1·54	2·16	96·0
7·69	7	E 325	0·52			0·63		6·87	4·27	2·15	95·5
12·76	7	N 182	0·83			0·62		6·88	4·49	2·17	96·3
14·08	7	N 215	1·03			0·49		8·06	2·44	2·15	95·4
12·41	6	J 49	1·37			0·64		10·26	1·63	2·55	113·4
				CROP FAILED	CROP FAILED		CROP FAILED				
Mean			1·10			0·53		8·64	2·36	2·25	100·0
Standard error			0·17			—		0·77	0·54	0·12	5·4
Significant difference (P=·05)			0·53			—		2·22	1·53	—	—

Experiment XVIII.—Clonal Selection Trials

These trials consist of a series of 6 × 6 latin squares, wherein the yields of rooted cuttings of potential selections are compared. Planting commenced in April, 1943; additional squares have been planted up subsequently as material became available. By the end of 1948, fourteen squares had been planted, of which thirteen were in bearing. All squares planted prior to April, 1944 (eight in number) have been pruned on the single stem system; those planted subsequently have been grown on multiple stem. Each square is planted with the following shade trees, in such a way that each clone is represented once by a different semi-permanent shade tree in the centre of each plot :—

Semi-permanent :—*Albizzia moluccana*
Albizzia stipulata
Albizzia sp. ("Tangasale")
Cordia holstii
Ficus sycamorus
Mæsopsis eminii
Permanent :— *Albizzia maranguensis*

In addition to yield records, samples have this year been taken throughout for purposes of out-turn, bean analyses, and liquoring reports.

Yearly yields and mean yields for each square are given below, the calculated yields of the original parents being included for reference. Except where otherwise indicated, the yields, expressed as cwts. of clean coffee per acre, have been calculated on a sixteen per cent out-turn basis.

The liquoring reports on samples from these selections show that all except six are classified as Class 1 or 2. In the case of the six the lower classification appears to be due to a taint probably caused by faulty preparation. N. 39 is again placed in Class 1 and the Liquorer regards the sample of N. 5 as "an extremely fine specimen" and placed it in Class 1.

H. 66 (Latin Square VIII) is an outstandingly vigorous tree, after having yielded at the rate of just over a ton of clean coffee to the acre in 1947, it yielded at the rate of 7·72 cwts. of clean coffee in 1948 and has a mean yield for its four bearing years of 8·51 cwts. of clean coffee per acre.

Latin Square I.—Planted 29/4/43—Single Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone	1945	1946	1947	1948	Mean of 4 years 1945-48 Cwt.	Percentage
						*		
16·83	7	N 39	4·84	1·30	*13·61	2·46	5·55	115·3
10·17	7	R 23	1·29	1·44	12·32	0·52	3·89	80·8
13·59	7	N 71	1·37	2·18	12·09	1·12	4·19	87·1
32·48	1	I 60	2·04	3·52	14·98	1·10	5·41	112·4
6·69	4	M 2	1·90	3·37	12·07	1·97	4·82	100·2
11·44	8	L 1	2·33	2·04	14·45	1·23	5·01	104·2
Mean			2·29	2·31	13·25	1·40	4·81	100·0
Standard error			0·26	0·45	—	0·32	0·21	4·4
Significant difference (P = ·05)			0·76	1·32	—	0·94	0·63	13·1

*Using actual out-turn.

Latin Square II.—Planted 30/4/43—Single Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone	1945	1946	1947	1948 *	Mean of 4 years 1945-48 Cwt.	Percentage
17·12	7	N 20	1·44	2·22	10·54	1·25	3·86	83·1
12·54	7	N 30	2·98	0·95	10·54	0·86	3·83	82·5
14·39	7	N 29	3·03	2·43	12·31	1·59	4·84	104·1
14·55	7	N 5	5·29	0·93	*12·92	1·06	5·05	108·7
32·04	1	N 48	2·06	2·43	10·81	0·73	4·01	86·3
13·88	7	N 197	4·17	5·33	*14·07	1·60	6·29	135·4
Mean			3·17	2·39	11·87	1·18	4·65	100·0
Standard error			0·33	0·46	—	0·18	0·29	6·2
Significant difference (P = ·05)			1·39	1·35	—	0·53	0·85	18·4

*Using actual out-turn.

Latin Square III.—Planted 26/10/44—Multiple Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone	1947	1948 *	Mean of 2 years 1947-48 Cwt.	Percentage
14·55	7	N 5	*6·26	11·42	8·84	105·3
13·77	6	AB 35	4·56	11·60	8·08	96·3
12·19	11	KP 154	3·25	13·40	8·32	99·2
14·35	11	KP 423	6·82	13·48	10·15	121·0
5·04	4	M 97	5·51	10·51	8·01	95·4
12·13	7	N 106	5·79	8·10	6·95	82·8
Mean			5·37	11·42	8·39	100·0
Standard error			—	0·62	0·40	4·8
Significant difference (P = ·05)			—	1·84	1·18	14·0

*Using actual out-turn.

Latin Square VII.—Planted 7/6/43—Single Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone	1945	1946	1947	1948 *	Mean of 4 years 1945-48 Cwt.	Percentage
13·87	7	R 15	3·63	2·50	*13·13	0·94	5·05	102·8
11·23	7	N 81	3·76	3·65	*15·43	2·92	6·44	131·2
9·01	11	KP 228	2·80	2·80	14·62	5·79	6·50	132·5
10·45	7	I 49	2·14	1·43	10·78	1·24	3·89	79·3
3·75	3	S 16	2·32	0·95	10·43	1·18	3·72	75·7
15·19	7	N 34	1·68	1·90	10·57	1·28	3·86	78·6
Mean			2·73	2·21	12·49	2·23	4·91	100·0
Standard error			0·44	0·38	—	0·42	0·34	7·0
Significant difference (P = ·05)			1·30	1·12	—	1·25	1·01	20·6

*Using actual out-turn.

Latin Square VIII.—Planted 13/8/43—Single Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone	1945	1946	1947	1948 *	Mean of 4 years 1945-48 Cwt.	Percentage
14·02	7	R 2	2·38	4·55	13·75	1·28	5·49	95·9
11·27	4	H 66	2·58	3·47	*20·28	7·72	8·51	148·7
6·14	4	M 7	1·46	3·48	11·24	1·96	4·54	79·3
11·95	6	AB 92	0·95	3·20	11·43	2·36	4·48	78·3
15·04	7	N 218	2·23	2·25	14·62	3·26	5·59	97·6
13·58	7	N 100	2·22	4·65	*14·30	1·77	5·73	100·2
Mean			1·97	3·59	14·27	3·06	5·72	100·0
Standard error			0·35	0·47	—	0·68	0·36	6·3
Significant difference (P = ·05)			1·02	1·38	—	2·00	1·06	18·5

*Using actual out-turn.

Latin Square IX.—Planted 20/12/43—Single Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone	1946	1947	1948 *	Mean of 3 years 1946-48 Cwt.	Percentage
10·49	6	AC 98	4·07	9·54	4·24	5·95	91·0
18·38	7	R 3	5·22	10·12	1·70	5·68	86·8
10·15	11	KP 683	4·46	13·63	4·78	7·62	116·4
14·07	7	N 205	6·60	13·02	3·10	7·57	115·7
10·94	7	N 128	4·87	12·91	1·75	6·50	99·3
11·29	7	I 5	4·58	10·39	2·87	5·94	90·8
Mean			4·96	11·60	3·07	6·54	100·0
Standard error			—	—	0·51	0·36	5·5
Significant difference (P = ·05)			—	—	1·49	1·07	16·3

*Using actual out-turn.

Latin Square X.—Planted 29/12/43—Single Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone	1946	1947	1948*	Mean of 3 years 1946-48 Cwt.	Percentage
36.90	1	N 110	4·79	12·99	3·02	6·93	95·6
7·37	3	M 95	4·13	11·16	0·93	5·41	74·5
10·99	11	KP 532	5·36	16·03	8·32	9·90	136·5
13·88	7	N 197	9·50	*1370	3·13	8·78	121·0
11·98	7	I 235	5·15	12·05	2·38	6·53	90·0
11·71	7	R 11	5·18	11·14	1·62	5·98	82·4
Mean			5·69	12·85	3·24	7·25	100·0
Standard error			—	—	0·64	0·32	4·4
Significant difference (P = ·05)			—	—	1·90	0·95	13·1

*Using actual out-turn.

Latin Square XI.—Planted 16/4/46—Multiple Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone		*1948 Cwt.	*1948 Percentage
9·22	11	KI	363	3·01	181·7
13·88	7	N	197	1·18	71·5
13·58	7	N	100	1·80	108·6
18·38	7	R	3	1·20	72·6
14·55	7	N	5	1·67	100·7
16·83	7	N	39	1·08	65·0
Mean				1·66	100·0
Standard error				0·21	12·5
Significant difference (P = ·05)				0·61	36·8

*Using actual out-turn.

Latin Square XII.—Planted 16/4/46—Multiple Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone		*1948 Cwt.	*1948 Percentage
10·58	11	KP	227	3·16	119·2
11·81	7	N	181	3·50	131·9
13·58	7	N	100	3·29	124·0
10·03	7	R	24	1·76	66·4
12·10	11	KP	231	0·89	33·5
12·72	11	KP	163	3·32	125·1
Mean				2·65	100·0
Standard error				0·55	20·7
Significant difference (P = ·05)				1·62	61·1

*Using actual out-turn.

Latin Square XIII.—Planted 26/4/46—Multiple Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone		*1948 Cwt.	*1948 Percentage
11·27	5	X	321	2·71	116·1
10·76	6	AC	189	3·49	149·9
13·58	7	N	100	0·79	34·0
Mean				2·33	100·0
Standard error				0·72	30·7
Significant difference (P = ·05)				—	—

*Using actual out-turn.

Latin Square XV.—Planted 26/1/44—Single Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone		1946	1947	1948 *	Mean of 3 years 1946-48 Cwt.	Mean of 3 years 1946-48 Percentage
11·95	6	AB	11	1·63	12·63	2·61	5·62	109·7
15·20	7	N	50	0·82	9·82	1·72	4·12	80·5
11·44	8	L	1	1·17	13·66	2·74	5·86	114·3
9·38	11	KP	263	1·54	9·62	6·38	5·85	114·1
11·83	7	I	47	1·23	10·73	2·23	4·73	92·3
14·08	7	N	215	1·95	9·97	1·79	4·57	89·2
Mean				1·39	11·07	2·91	5·12	100·0
Standard error				—	—	0·61	0·31	6·0
Significant difference (P = ·05)				—	—	1·79	0·91	17·7

*Using actual out-turn.

Latin Square XVI.—Planted 3/3/44—Single Stem

Yields calculated as cwts. of clean coffee per acre

Mean Yield	Parent No. of years recorded	Clone	1946	1947	1948 *	Mean of 3 years 1946-48 Cwt.	Percentage
11·27	7	N 198	0·72	7·93	2·67	3·77	99·1
18·38	7	R 3	0·66	7·88	0·87	3·14	82·5
8·38	7	R 25	0·66	7·04	2·01	3·24	85·0
12·63	7	N 76	0·83	8·83	3·89	4·51	118·5
13·31	7	N 220	0·86	4·85	2·87	2·86	75·1
13·88	7	N 197	1·33	*9·29	5·34	5·32	139·7
Mean			0·85	7·64	2·94	3·81	100·0
Standard error			—	—	0·60	0·25	6·5
Significant difference (P = ·05)			—	—	1·78	0·74	19·3

*Using actual out-turn.

Latin Square XVII.—Planted 13/9/45—Multiple Stem

Yields calculated as cwts. of clean coffee per acre

Mean Yield	Parent No. of years recorded	Clone	*1948 Cwt.	Percentage
7·26	11	KP 162	6·76	127·9
15·19	7	N 34	7·20	136·1
14·71	7	N 14	1·90	35·9
12·66	7	I 56	4·84	91·5
18·38	7	R 3	4·99	94·3
7·13	7	F 502	6·05	114·3
Mean			5·29	100·0
Standard error			0·91	17·1
Significant difference (P = ·05)			2·67	50·5

*Using actual out-turn.

Experiment IV.—Squares II, V and IX—Clonal Selection Trials

The three original squares in experiment IV were uprooted, because of the unsuitability of the various exotic coffees planted therein. As material became available, they were each replanted with the same five clones, squares II and V being grown on the single stem system and square IX on multiple stem. The spacing is 8′ × 8′ apart.

The results have been disappointing, probably due to the heavy shade, prior to 1948, of *Acrocarpus fraxinifolius*, *Cordia holstii*, and *Albizzia maranguensis*, and the previous existence of coffee in the area.

Yields, expressed as cwts. of clean coffee per acre, are given below :—

Latin Square V.—Planted 9/4/42—Single Stem

Yields calculated as cwts. of clean coffee per acre

Mean Yield	Parent No. of years recorded	Clone	1945	1946	1947	1948	Mean of 4 years 1945-48 Cwt.	Percentage
16·83	7	N 39	2·47	CROP FAILED	3·28	5·76	2·78	85·2
18·38	7	R 3	4·37		8·52	0·88	3·15	96·5
11·44	8	L 1	3·86		9·58	1·51	3·41	104·5
13·58	7	N 100	2·97		9·74	0·93	3·07	94·1
13·88	7	N 197	4·23		10·09	2·65	3·90	119·6
Mean			3·58		8·24	2·35	3·26	100·0
Standard error			0·33		—	0·459	0·143	4·4
Significant difference (P = ·05)			1·02		—	1·415	0·44	13·5

Latin Square II.—Planted 13/4/43—Single Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone	1945	1946	1947	1948	Mean of 4 years 1945-48 Cwt.	Mean of 4 years 1945-48 Percentage
16·83	7	N 39	1·11	CROP FAILED	4·84	2·34	1·90	87·3
18·38	7	R 3	1·31		6·56	0·38	1·83	83·8
11·44	8	L 1	1·40		8·21	1·51	2·48	113·8
13·58	7	N 100	1·19		7·64	1·01	2·19	100·2
13·88	7	N 197	1·64		8·08	1·48	2·50	114·8
Mean			1·33		7·07	1·34	2·18	100·0
Standard error			0·15		—	0·351	0·097	4·4
Significant difference	(P = ·05)		0·45		—	1·083	0·298	13·7

Latin Square IX.—Planted 17/3/44—Multiple Stem

Yields calculated as cwts. of clean coffee per acre

Parent Mean Yield	No. of years recorded	Clone	1948 Cwt.	1948 Percentage
16·83	7	N 39	2·19	91·7
18·38	7	R 3	2·34	98·0
11·44	8	L 1	1·94	81·4
13·58	7	N 100	2·61	109·2
13·88	7	N 197	2·86	119·7
Mean			2·39	100·0
Standard error			0·440	18·4
Significant difference			—	—

Experiment III.—Clones *v.* Seedlings—Planted 1938

This experiment was originally designed to compare clones (rooted cuttings) with seedlings of the same parent, both by themselves and as root-stocks grafted with scions from another single mother-tree. The trees are pruned on the single stem system and the area is lightly shaded with *Albizzia maranguensis*. Although planted in 1938 (as a 4 × 4 latin square), difficulties regarding the technique of grafting in the field were experienced. The advent of the war, and consequent shortage of staff, aggravated the position, and even now there are a number of missing trees. In an endeavour to obtain further evidence regarding the respective merits of rooted cuttings and seedlings of the same parents (cf. Experiment IIIA below), it was decided to commence recording the yields of this experiment this year, making due allowance for the missing trees.

Treatments.

A.—V.G. 171 grafted on seeding stocks of parent trees "Y".

B.—Clones of "Y"—rooted cuttings.

C.—V.G. 171 grafted on clonal stocks of parent trees "Y".

D.—Seedlings of "Y".

(*N.B.*—"Y" is represented by ten mother-trees.)

The yields for the 1948 crop, adjusted for the number of trees, are shown in Table 3.

TABLE 3

Yields calculated as cwts. of clean coffee per acre

	A V.G. 171 Seedlings	B Clones	C V.G. 171 Clones	D Seedlings	Mean	Standard Error
Cwt. per acre	9·58	9·15	10·57	12·06	10·34	0·611
Percentage	92·6	88·5	102·2	116·6	100·0	5·9

It can be seen that seedlings have outyielded rooted cuttings this year (as in Experiment IIIa). A comparison of the yields of clones and seedlings only in this experiment shows that seedlings gave a significantly (P = ·02) higher yield than clones.

Experiment IIIa.—Clones *v.* Seedlings—Planted 1942

This is designed to give a straight comparison between clones (rooted cuttings) and seedling progeny of the same mother-trees; the experiment is laid out as randomized blocks repeated ten times; the trees are pruned on the single stem system. Shade is afforded by *Albizzia stipulata* and *Mæsopsis eminii*, with *Albizzia maranguensis* as the permanent shade tree. As in Experiment III there are a number of missing trees for which allowance has been made in the analysis. This correction is for differences in numbers only. The records of the experiment having been kept by plots and not by individual trees, it is not possible to correct the analysis for the differences in yield of the progeny of the various mother trees represented in the experiment. Individual tree records will be kept in future.

The yearly yields, calculated as cwts. of clean coffee per acre, are shown in Table 4.

TABLE 4

	1945	1946	1947	1948	Mean of 4 years 1945-48 Cwt.	Mean of 4 years 1945-48 Percentage
Clones	3·17	CROP FAILED	5·45	8·48	4·40	104·2
Seedlings	2·06		4·66	9·44	4·05	95·8
Mean	2·62		5·06	8·96	4·23	100·0
Standard error	0·23		0·17	0·46	0·159	3·8
Significant difference (P = ·05)	0·75		0·55	—	—	—

Seedlings have outyielded clones for the first time in 1948, though the difference is not significant. Clones maintain a slight superiority over the mean of the four-year period 1945-48, but here again the difference is not significant.

SECTION III.—VEGETATIVE PROPAGATION

Horticulturist's Report

The year was largely one of reorganization and preparation for the renewal of experimental work on the technique of rooting coffee cuttings, after a lapse during the war and immediate post-war years. From observation and experience, it was considered that the following factors merited further investigation as being the most likely to influence rooting under the conditions prevailing at this Station :—

(1) condition of cuttings;
(2) preparation and planting of cuttings;
(3) moisture, temperature and light;
(4) rooting media.

In addition, a most serious problem was the very high rate of mortality after rooting. This occurred both in the frames after potting-up and when hardening-off outside prior to planting in nursery beds. Losses in the beds themselves were negligible.

(1) Condition of Cuttings

Repeated observation has clearly shown that the most satisfactory type of cutting is a softwood leafy cutting which is hard or semi-hard at the base. This agrees with the findings of Guiscafré-Arrillaga(*) in Puerto Rico. In practice this type of cutting is never so readily available as the true softwood cutting, and production of clonal material would be greatly retarded if all suckers were left on the mother-trees until this condition was attained. Investigations have therefore been continued into methods of improving the technique of rooting true softwood cuttings, and in the meantime observations regarding the incidence of early hardening of the bases of potential cuttings are being noted.

Advantage was taken of the occurrence of a number of suckers on established single stem trees of clones in the field to compare the rooting capacity of these suckers, planted as cuttings, with those from mother-trees of the same clones, especially grown for the purpose in the nursery. The results are shown in Table 1.

TABLE 1

PERCENTAGE ROOTED

	R. 15	KP. 228	N. 34	I. 49	S. 16	Mean	* S.E.	Sig. Diff (P.=·05)
Field	5	55	33	26	18	27·4	—	—
Nursery	25	62	66	39	78	54·0	—	—
Mean	15·0	58·5	49·5	32·5	48·0	40·7	6·7	26·3

*S.E. = Standard error.

The easier rooting of the cuttings taken from the mother-trees in the nursery confirms the experience of Gibbins(†); the condition of the cuttings from the trees in the field, occasioned by the heavier shade, is probably the factor mainly responsible for the poorer rooting response in this instance. The low standard of rooting generally in this experiment is due to the unsatisfactory rooting medium, type of basal cut, and conditions of light, which were in general use at the time, and are reported upon later.

(2) Preparation and Planting of Cuttings

(a) *Trimming of leaves.*—It is a generally accepted principle of propagation by softwood cuttings that as many leaves as possible, proportionate to the size of the cutting, should be retained. In practice, at the Coffee Research Station the basal pair have been removed and the remainder trimmed, mostly to save space in the propagating frames. A series of comparative trials were laid down to see whether the retention of entire leaves, without trimming, would aid rooting. The results are given in Table 2.

TABLE 2

PERCENTAGE ROOTED

	F. 840	KIL. 10(1)	KIL. 10(2)	N. 5	N. 197 (1)	N. 197 (2)	R. 15 (1)	R.15 (2)	Mean	S.E.	Sig. Diff. (P.=·001)
Trimmed	96·5	86·6	45·7	62·5	74·0	56·0	88·0	35·1	68·1	—	—
Untrimmed	68·9	74·0	22·5	35·0	30·0	34·0	52·0	25·9	42·8	—	—
Mean	82·7	80·3	34·1	48·8	52·0	45·0	70·0	30·5	55·4	2·9	22·2

(*) Guiscafré-Arrillaga, J. (1946)—"The Propagation of Coffee (*Coffea arabica* L.) by Cuttings". *Proc. Amer. Soc. Hort. Sci.*, 48 : 279-290.

(†) Gibbins, C. B. (1937)—3rd Ann. Rep. Coffee Res. Sta., 1936, Section IV, pp. 40-41.

(Apart from differences in rooting capacity between clones, variability within a treatment may be accounted for by the different rooting media in which the cuttings of the various clones were planted).

It can thus be seen that in every case the trimming of the leaves appears to aid rooting. These results must, however, be treated with some reserve, since it was apparent that the untrimmed cuttings were shading the medium in which they were planted and preventing the water (applied as a spray) from being evenly distributed. The dryness at the base of the cuttings may account, at least in part, for the poorer results when the leaves were left entire, and the actual mutilation (by trimming) may not have stimulated rooting to such an extent as at first seems probable. The question of spacing is obviously linked up here.

(b) *Basal Cut.*—Early experiments with different types and positions of basal cut(†) had failed to influence rooting capacity to any appreciable extent, and horizontal or semi-spherical cuts just below a node was employed as a routine method. In view of the greatly improved technique since those early days, it was decided to try other methods once again.

Two preliminary non-replicated trials were therefore laid down in the first instance to ascertain whether any improvement over the routine method was likely to be gained. In the first trial, there were only two treatments, as follows :—

A.—Cut just below a node and stem split longitudinally for about 1″ from the base.

B.—Control-cut just below a node.

After twenty-four weeks, eighty-eight per cent of the split cuttings had rooted in an average of 16·32 weeks; in the same period seventy-five per cent of the controls had rooted, taking an average of 16·91 weeks to root.

There were four treatments in the second trial, viz :—

A.—Internodal wedge (two-sided) cut (top of cut at node).

B.—Internodal slanting (one-sided) cut (top of cut at node).

C.—Nodal horizontal cut—control.

D.—Internodal horizontal cut.

The terms "nodal" and "internodal" are here used to indicate the positions whence the cuttings were severed from the mother-tree. In treatments A and B, where the cuts are oblique, the top of the cut actually starts at the node, though the point of severance is internodal, and they are therefore directly comparable with the other two treatments.

The results, after twenty-four weeks, are summarized in the following table :—

TABLE 3

Treatment	Percentage rooted	Average No. of weeks to root
A	68	14·24
B	66	19·39
C	46	17·39
D	68	16·59

(†) Gibbins, C. B. (1937)—3rd Ann. Rep. Coffee Res. Sta., 1936, Section IV, pp. 40-41.

In a direct comparison between the nodal position (treatment C) and the internodal positions (treatments A, B and D), the difference is highly significant ($\times^2 = 7{\cdot}245$).

Thus it can be seen from these preliminary trials that there appears to be some advantage in using the internodal position as the point of severance of cutting, and a suspicion that the hitherto normal method of basal cut, namely an horizontal cut just below a node, may not be the best for softwood coffee cuttings. Immediate preparations were made for the laying down of replicated experiments, in an endeavour to elucidate this problem.

(c) *Spacing.*—There are indications that the present density (i.e. 200 cuttings per standard frame or an area of 6·40 square inches per cutting) may not be the most satisfactory to obtain the maximum number of cuttings rooted. The question of trimming the leaves (referred to above) is obviously bound up with this, but in the final instance it is probably an economic problem, largely determined by the availability of the particular material which it is desired to propagate.

A spacing trial was included as sub-treatments in an experiment to control the temperature in the frames during the hot season. The results are given in Tables 5 and 6 below under the heading of "Moisture, Temperature and Light". The two spacing treatments were planting densities of 6·40 square inches per cutting and 12·80 square inches per cutting respectively. It can be seen from Table 5 that the wider spacing has caused an appreciably higher percentage number of cuttings to root than the closer one, and this difference is significant at the one per cent level of probability. The mean time required to root is also reduced (Table 6), but this difference is not significant.

(3) Moisture, Temperature and Light

It has been found that rooting is most successful during and immediately after the cool season, i.e. during the period July to October approximately. It was decided to lay down a trial, during the hottest months, wherein attempts would be made to lower the temperatures in the frames by cooling with water on the outside of the glass. The trial was laid out as two randomized blocks, each containing three plots; each plot was further divided into sub-plots as a spacing trial.

The treatments were as follows :—

(1) *Main plots.*

A.—Continuous spray of water on to outside of glass from 7.30 a.m. to 5.30 p.m.

B.—Water applied hourly by can on outside of glass from 7.30 a.m. to 5.30 p.m.

C.—Control—no water on outside of glass.

(2) *Sub-plots.*

Y.—Planting density of 6·40 square inches per cutting.

R.—Planting density of 12·80 square inches per cutting.

The maximum and minimum temperatures were recorded daily, and the means in each treatment, together with the mean variation, for the duration of the experiment are shown in the following table :—

TABLE 4

TEMPERATURES

DEGREES CENTIGRADE

	Max.	Min.	Mean	Variation
A	25·6	16·0	20·8	9·6
B	28·8	16·9	22·85	12·0
C	30·3	16·8	23·55	13·5
Mean	28·2	16·6	22·4	11·7

The continuous stream of water on the outside of the glass has reduced the mean maximum temperature by nearly 5°C and the mean minimum by nearly 1°C. The variation, however, while reduced by nearly 4°C, still remains as high as 9·6°C.

The percentage number of cuttings rooted and the time taken to root in the different treatments are given in Tables 5 and 6 respectively.

TABLE 5

PERCENTAGE NUMBER OF CUTTINGS ROOTED

	A	B	C	Mean
Y	21·0	39·0	46·0	35·3
R	36·0	50·0	79·0	55·0
Mean	28·5	44·5	62·5	45·2

Standard error for the body of the table	3·5
,, ,, ,, main treatments	17·7
,, ,, ,, sub-treatments (spacing) ...	2·0
Significant difference for spacing (P = ·01)	16·5

TABLE 6

NUMBER OF WEEKS TO ROOT

	A	B	C	Mean
Y	15·5	19·4	19·8	18·2
R	15·7	17·0	17·8	16·8
Mean	15·6	18·2	18·8	17·5

Standard error for the body of the table	1·4
,, ,, ,, sub-treatments (spacing) ...	0·8
,, ,, ,, main treatments	0·5
Significant difference for main treatments (P = ·05)...	3·0

Although the differences between the main treatments are not significant, it can be seen that the application of water on the outside of the glass appears to have had an adverse effect on the number of cuttings rooted. To some extent this may be accounted for by an outbreak of leaf disease (*Hemileia vastatrix*) in those frames receiving the water on the outside. The continuous supply of water on the outside of the glass has, however, reduced the time required for rooting and this difference is significant at the five per cent level of probability.

The results of the sub-treatments have already been discussed under "spacing" above.

Light.—Great importance is attached to the question of shade over the frames. The present system of shading with hessian cloth is expensive, and is not entirely satisfactory throughout the year. Trials with other materials and systems will be put in hand later, after observation both on unrooted and rooted cuttings.

(4) Rooting Media

Experiments conducted before the war indicated the superiority of German peat moss as a rooting medium, when mixed with coarse river sand. The expense of importing this material renders its use impracticable on a large scale, and it was decided to continue the search for a good local substitute. Coconut fibre had already proved its worth, but the possibilities of other materials more readily available in the coffee-growing areas still remained to be explored.

In 1946 Gilbert(‡) reported on the use of coffee parchment (husk) as a rooting medium, and between then and 1948 large numbers of cuttings were successfully rooted at the Coffee Research Station in a mixture of parchment and coarse river sand. Losses, however, were high, and, on the resumption of experimental work, it was decided to compare the merits of this material with those of coconut fibre. Some peat moss was also obtained from England for inclusion in these trials.

In the first trial, the treatments were as follows :—

	Volume
A.—Peat moss + coconut fibre + coarse river sand ...	1 :1 :1
B.—Coffee parchment + coarse river sand	1 :2
C.—Peat moss + coarse river sand	2 :1
D.—Coconut fibre + coarse river sand	2 :1
E.—Washed river sand (stones removed)	3
F.—Coarse river sand + fine washed river sand ...	1 :1

The experiment was laid out as two randomized blocks, contained within six frames; in each plot there were 100 cuttings, representing three different clones. The experiment was closed after twenty-four weeks in the frames, and the percentage number of cuttings rooted in each treatment is shown in Table 7.

TABLE 7

PERCENTAGE ROOTED

	A	B	C	D	E	F	Mean	S.E.	Sig. Diff. (P = ·05)
Block I ...	78	51	85	74	23	38	58·2	—	—
Block II ...	77	49	70	53	17	15	46·8	—	—
Mean	77·5	50·0	77·5	63·5	20·0	26·5	52·5	4·9	17·8

Peat moss has thus once again demonstrated its superiority over other material as the organic ingredient of a rooting medium for coffee cuttings. Coffee parchment is shown as being inferior to both peat moss and coconut fibre, while sand by itself, in the absence of any organic material, cannot be considered effective.

(‡) Gilbert, S. M. (1946)—"Note on the Vegetative Propagation of *Coffea arabica*". *E. Afr. Agric. Jour.* 12, 2 : 73, Oct. 1946.

Six months later this same experiment was repeated, using the original materials in treatments A, B, C and D, but substituting the following coffee parchment/sand mixtures for the unsatisfactory sand alone used in treatments E and F :—

	Volume
E.—Coffee parchment + coarse river sand	1 :2 fresh
F.— ,, ,, + ,, ,, ,, ...	2 :1 ,,

The materials in treatments A, B, C and D were therefore six months old, while those in E and F were fresh. The results, expressed as percentage number of cuttings rooted, are shown in Table 8.

TABLE 8

PERCENTAGE ROOTED

	A	B	C	D	E	F	Mean	S.E.	Sig. Diff. (P=·05)
Block I ...	60	54	83	57	63	28	57·5	—	—
Block II ...	69	77	71	78	69	18	63·7	—	—
Mean	64·5	65·5	77·0	67·5	66·0	23·0	60·6	7·6	27·6

Apart from the poorer performance of treatment A, the same tendencies in the first four treatments A, B, C and D are apparent here as in the first trial, and the superiority of the peat moss-sand mixture is confirmed. The differences between the 1 :2 and 2 :1 proportions of the coffee parchment/sand mixtures are considerable.

Partial decomposition of the parchment was fairly rapid, and in addition a tendency for the 2 :1 mixture (treatment F) to "bind" was noticeable; the cause of this was presumably insufficient aeration, due to lack of sand.

The main attributes of an efficient rooting medium for softwood cuttings are good aeration and a high moisture-retaining capacity. Coffee parchment does not appear to fulfil these conditions, and this is the probable explanation of the better rooting response, when the proportion of parchment is decreased and that of sand is increased.

Vermiculite.—Vermiculite is a laminated micaceous mineral which is found in East Africa among other places. Workers in the United States claimed that this mineral, when expanded or exfoliated by heating to very high temperatures, was the best propagating medium available, generally giving better results than sand. Its water-holding capacity is stated to be very good, while its porous nature ensures a high degree of aeration.

Since control of watering is probably one of the limiting factors to the successful propagation of coffee by cuttings under local conditions, it was considered worthwhile to explore the possibilities of this material. Through the kindness of Messrs. Kenya Kyanite Ltd., of Nairobi, some vermiculite was obtained from Kenya. Trials were laid down using it both alone and in mixtures with peat moss and coconut fibre. The results in the first trial were disappointing; the percentage number of cuttings rooted in all treatments was low, and the treatment differences were not significant. The trial was accordingly repeated six months later, using the original materials as previously, but substituting fresh cuttings. In this second trial, results were more satisfactory, but again the differences were not significant. Further trials are obviously necessary and will be undertaken as opportunity occurs. The superiority of peat moss as a component of the rooting medium was again demonstrated.

The percentage number of cuttings rooted in each of these trials is shown in Table 9.

TABLE 9

Trial	Block		A Peat moss + Vermiculite (—10 + 20) 2 : 1	B Peat moss + Vermiculite (—12 + 20) 2 : 1	C Coconut Fibre + Vermiculite (—10 + 20) 2 : 1	D Coconut Fibre + Vermiculite (—12 + 20) 2 : 1	E Peat moss + Vermiculite (—10 + 12) 2 : 1	F Vermiculite (—10 + 20)	G Peat moss + Coarse sand 2 : 1	H Tree fern + Coarse sand 2 : 1	Mean	S.E.
1	1	...	62	80	28	14	20	34	40	26	38·0	—
	2	...	58	24	46	34	86	22	36	38	43·0	—
	Mean	...	60·0	52·0	37·0	24·0	53·0	28·0	38·0	32·0	40·5	17·3
2	1	...	88	92	72	48	96	80	82	76	79·25	—
	2	...	78	70	76	66	90	86	94	54	76·75	—
	Mean	...	83·0	81·0	74·0	57·0	93·0	83·0	88·0	65·0	78·0	7·5

Tree Fern.—The outer bark of the dried stems of the Tree Fern (*Cyathea usambarensis* Hieron), found in the forest on Kilimanjaro, was broken up and sifted, and tried as a rooting medium after mixing with coarse river sand. This preliminary treatment was included in the Vermiculite trials mentioned above. It can be seen from Table 9 that results were not up to the standard of the peat moss mixture, but further trials, possibly with different grades of material, are obviously merited.

Wild Date Palm Fibre.—This fibre was obtained from the dry leaf bases of the Wild Date Palm (*Phœnix reclinata* Jacq.) which abounds in the river gorges on Kilimanjaro in the lower forest and in the upper coffee-growing areas. Well broken-up and sifted, it was mixed with coarse river sand in the proportion of 2 :1 by volume. A trial with two replicates was laid down to compare it with coconut fibre and sand in similar proportions. The results, which are not significant, are shown in the following table :—

TABLE 10

PERCENTAGE ROOTED

	A Coconut fibre and sand 2 : 1	B Wild Date Palm fibre and sand 2 : 1	Mean	Standard Error
Block I	27	95	61	—
Block II	19	45	32	—
Mean ...	23·0	70·0	46·5	15·4

The poor results in the coconut fibre mixture must be attributed to a bad sample of coconut husk which still contained a number of small hard lumps after repeated chopping and sifting. For a time the date palm fibre medium in Block I was infested with termites. After this invasion, it was noticed that the medium presented a very light and well aerated appearance with very few long fibres. It seems probable that the termites were consuming these

fibres, and in the process kept the medium open, thus accelerating the rooting of the cuttings. The cuttings themselves were not attacked. In spite of the unsatisfactory results of the trial, this material obviously has great promise and further trials with it have been laid down.

(5) Rooted Cuttings

It has been the usual practice to pot up the young rooted cuttings into baskets made of banana-stem fibre. The potting mixture was a rich compost, to which a proportion of the rooting medium used was added. After potting, the young plants were returned to the frames for 2-3 weeks to recover from the check of transplanting, and were then placed outside under shade for a further 3-4 weeks to complete the hardening-off process.

The percentage losses, during the whole of this hardening-off process, for the first six months of 1948 are given in Table 11.

TABLE 11

	Jan.	Feb.	March	April	May	June	Total
Total rooted	1,359	949	1,059	1,519	1,426	1,156	7,468
Total died after rooting	757	277	209	205	251	275	1,974
Percentage died after rooting ...	55·7	29·2	19·7	13·5	17·6	23·8	26·4

The majority of cuttings potted during this period had been rooted in a coffee parchment/sand mixture, and this was therefore added to the potting mixture. It was noticed that the resultant compost in the baskets tended to dry out very quickly and became hard and caked. It was therefore decided, in July, to try alternative potting mixtures. These were :—

1. Compost; leaf-mould; fine sand at 3 :1 :½ by volume.
2. Compost; coconut fibre; sand at 3 :1 :½ by volume.
3. Compost; sand at 4 :½ by volume.

The results were as follows :—

TABLE 12

Potting Mixture	No. Rooted	Died after rooting Total	Percentage
1	457 ...	86 ...	18·81
2	467 ...	135 ...	28·90
3	475 ...	121 ...	25·47
Total ...	1,399 ...	342 ...	24·44

From these figures, it appeared that some improvement could be hoped for by altering the potting mixture, and the compost/leaf mould/fine sand mixture was accordingly adopted thereafter.

The number of cuttings rooted, and losses after rooting, for the remainder of the year are shown in Table 13.

TABLE 13

	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total Aug/Dec.	Total Half year	Total for year
Total rooted	1,464	1,762	2,884	2,672	1,656	1,296	10,270	11,734	19,202
Total died after rooting	361	313	510	470	270	194	1,757	2,118	4,092
Percentage died after rooting.	24·6	17·8	17·7	17·6	16·3	14·9	17·1	18·1	21·3

Losses, however, still remained high, and it was apparent that there were other causes of this high mortality after rooting.

It had been observed that those cuttings which took a long time to root were never so robust and healthy as those which rooted quickly. In addition their original leaves had almost invariably been shed, leaving only a tuft of small new leaves produced in the humid atmosphere of the frame. It seemed probable that the mortality among cuttings of this type was high, and attempts were accordingly made to correlate the percentage number of deaths after rooting with the age of the cuttings.

Detailed analysis, according to age, of the cuttings rooted and those which died after rooting was carried out for the five months August-December inclusive, and the mean percentages died after rooting for this period were calculated according to the number of months taken to root. A correlation between the time taken for cuttings to root and the percentage number of deaths after rooting was found to be highly significant, ($r = \cdot 71$, $P = \cdot 001$).

Thus the longer the cuttings take to root the higher, on the average, will be the percentage number of deaths after rooting. It would appear, therefore, that any treatment which tended to hasten the rooting of the cuttings would also reduce the number of losses after potting-up.

In Figure 1 the mean percentage numbers of cuttings died after rooting are plotted against the time taken for the cuttings to root. The numbers rooting in less than two months or in more than fifteen months are comparatively small and therefore the percentage number of deaths after rooting at the extremes of the graph are somewhat erratic.

The line AB represents the regression of the time taken to root on the percentage number of deaths after rooting, and shows that a deviation from the mean time to root of one month is equivalent to an average deviation of 1·38 per cent from the mean percentage number of deaths after rooting. From this, it is possible to estimate the percentage number of deaths after rooting which will occur at any given period of time taken for the cuttings to root.

Summary

Cuttings taken from specially prepared mother-trees in the nursery rooted better than those from trees of the same clone which were growing in the field on the single stem system.

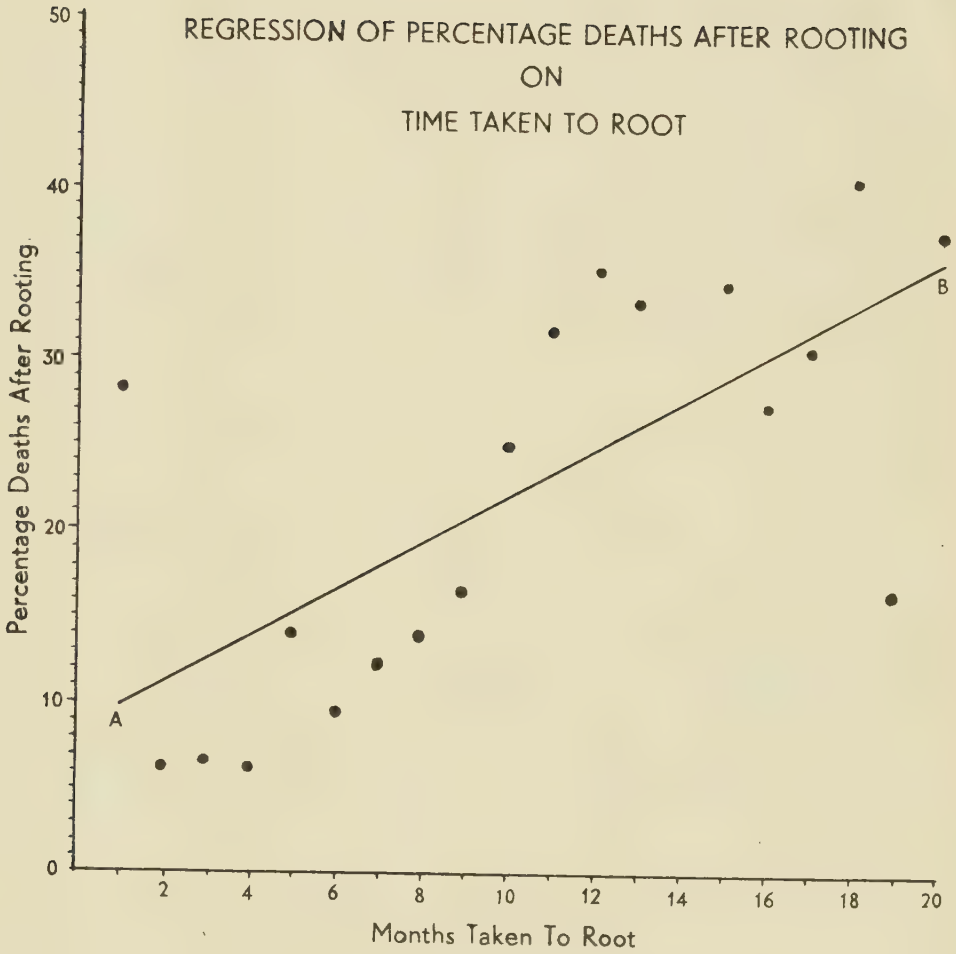
The trimming of the leaves of cuttings increased the percentage number rooted compared to those with untrimmed leaves, but the spacing of the cuttings may have been partly responsible for these results.

Preliminary trials with different types and positions of basal cut indicate that an horizontal cut just below a node (the routine method hitherto) may not be the best for softwood coffee cuttings.

It appears that the spacing of cuttings in the frames influences rooting, though the optimum density is largely an economic problem.

An attempt to reduce the internal temperature of the frames by cooling with water on the outside of the glass appeared to have an adverse effect on the number of cuttings rooted, although rooting was hastened by this means.

The superiority of peat moss as a component of the rooting medium was again confirmed. The proportions in a coffee parchment/sand mixture appear


REGRESSION OF PERCENTAGE DEATHS AFTER ROOTING
ON
TIME TAKEN TO ROOT
Percentage Deaths After Rooting
50
40
30
20
10
0
A
B
2
4
6
8
10
12
14
16
18
20
Months Taken To Root
Fig. 1

to influence the effectiveness of the parchment, the use of which as a rooting medium is discussed. The use of other materials, including vermiculite, is also discussed.

The total number of cuttings rooted during the year and the percentage number died after rooting are shown. A change in the potting mixture reduced the latter figure. A correlation between the time taken for cuttings to root and the percentage number of deaths after rooting was found to be highly significant.

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SECTION IV.—IMPROVEMENT OF GROWING CONDITIONS

Experiment V.—Mulch, Compost, and Nitrogen—Planted 1940

This is a partially confounded $3 \times 3 \times 3$ factorial experiment designed to determine the effects on yield of mulch, compost, and Sulphate of Ammonia at three quantity levels separately and in all combinations. The material used for mulching is dried elephant grass. The area is unshaded; the trees, which are unselected clonal material, are pruned on the single stem system.

Treatments.—(per tree).

Mulch —M0 = Nil.
—M1 = 40 lb. dried Elephant Grass.
—M2 = 80 ,, ,, ,, ,,

Compost— C0 = Nil.
— C1 = 1 debe (petrol tin) compost.
— C2 = 2 ,, ,, ,,

	1940-42	1943-45	1946-48
Nitrogen—			
N0 = ...	Nil.	Nil.	Nil.
N1 = ...	1 oz. Sulphate of Ammonia.	2 oz. Sulphate of Ammonia.	3 oz. Sulphate of Ammonia.
N2 = ...	2 oz. Sulphate of Ammonia.	4 oz. Sulphate of Ammonia.	6 oz. Sulphate of Ammonia.

The mulch is applied after the long rains; the compost is applied just before the long rains and is lightly forked-in; the Sulphate of Ammonia is applied after approximately fifteen inches of rain have fallen.

The results for the year 1948 are given in Tables 1-8 below.

TABLE 1

Interaction for Mulch and Compost 1948 Crop

Yields calculated as cwts. of clean coffee per acre (using actual out-turn)

	C0	C1	C2	Mean
M0 ...	23·162	19·747	20·615	21·175
M1 ...	21·024	21·228	18·775	20·343
M2 ...	20·075	18·677	19·546	19·433
Mean ...	21·420	19·884	19·645	20·317

Standard Error for marginal means ... ... ± 0·752
Standard Error for the body of table ... ... ± 1·303

TABLE 2

INTERACTION FOR MULCH AND NITROGEN (S/A) 1948 CROP

Yields calculated as cwts. of clean coffee per acre (using actual out-turn)

	N0	N1	N2	Mean
M0 ...	23·275	21·011	19·239	21·175
M1 ...	20·875	19·446	20·706	20·343
M2 ...	20·181	20·292	17·825	19·433
Mean ...	21·443	20·250	19·256	20·317

Standard Error for marginal means ... ... ± 0·752

Standard Error for the body of table ... ... ± 1·303

TABLE 3

INTERACTION OF COMPOST AND NITROGEN (S/A) 1948 CROP

Yields calculated as cwts. of clean coffee per acre (using actual out-turn)

	N0	N1	N2	Mean
C0 ...	22·807	22·119	19·335	21·420
C1 ...	21·204	18·812	19·637	19·884
C2 ...	20·320	19·818	18·799	19·645
Mean ...	21·443	20·250	19·256	20·317

Standard Error for marginal means ... ... ± 0·752

Standard Error for the body of table ... ... ± 1·303

TABLE 4

THREEWAY TABLE ADJUSTED FOR BLOCK EFFECTS, 1948 CROP

Yields calculated as cwts. of clean coffee per acre (using actual out-turn)

	N0			N1			N2		
	C0	C1	C2	C0	C1	C2	C0	C1	C2
M0 ...	22·749	22·388	24·685	25·168	17·790	20·070	21·568	19·061	17·086
M1 ...	24·761	20·408	17·452	21·013	20·832	16·487	17·295	22·440	22·379
M2 ...	20·909	20·812	18·818	20·173	17·809	22·890	19·139	17·408	16·926

The full analyses of this experiment were submitted to the Statistician of the East African Agricultural and Forestry Research Organization, who comments as follows:—

"Supporting the conclusion reached last year (by Rothamsted), nitrogen has significantly decreased the yield. Both mulching and compost also led to a decrease (though not significant), which is not in agreement with previous years. The high level of mulching, as in previous years, has again given a lower yield than the lower level, but this effect was not significant; and again there is little difference in the two levels of compost.

The interaction, mulch-compost, is not significant."

The mean yields for the seven-year period 1942-48 are shown in Tables 5-8 on pages 33-4.

TABLE 5

INTERACTION FOR MULCH AND COMPOST—MEAN YIELD OF 7 YEARS, 1942-48 CROP

Yields calculated as cwts. of clean coffee per acre (using actual out-turn)

	C0	C1	C2	Mean
M0	6·703	7·082	7·164	6·983
M1	6·969	7·423	6·968	7·120
M2	6·799	6·911	6·737	6·815
Mean	6·824	7·139	6·957	6·973

Standard Error for marginal means ... ... ± 0·129
Standard Error for the body of the table ... ± 0·225
Significant Difference for marginal means ... 0·365

TABLE 6

INTERACTION FOR MULCH AND NITROGEN (S/A)—MEAN OF 7 YEARS 1942-48 CROP

Yields calculated as cwts. of clean coffee per acre (using actual out-turn)

	N0	N1	N2	Mean
M0	7·389	7·076	6·485	6·983
M1	7·437	6·918	7·006	7·120
M2	7·068	6·927	6·451	6·815
Mean	7·299	6·974	6·647	6·973

Standard Error for marginal means ... ... ± 0·129
Standard Error for the body of the table ... ± 0·225
Significant Difference for marginal means ... 0·365

TABLE 7

INTERACTION OF COMPOST AND NITROGEN (S/A)—MEAN OF 7 YEARS 1942-48 CROP

Yields calculated as cwts. of clean coffee per acre (using actual out-turn)

	N0	N1	N2	Mean
C0	7·069	7·043	6·359	6·824
C1	7·434	7·001	6·981	7·139
C2	7·392	6·877	6·600	6·957
Mean	7·299	6·974	6·647	6·973

Standard Error for marginal means ... ... ± 0·129
Standard Error for the body of the table ... ± 0·225
Significant Difference for marginal means ... 0·365

The overall (i.e. total) effects of the treatments, as shown in Tables 5, 6 and 7 for the years 1942-48 are :—

(a) In combination with either level of compost and either level of mulch the application of Sulphate of Ammonia has had a depressing effect on yield, the total of these effects has resulted in a highly significant decrease in yield.

(b) In the case of mulch, the lower level (M1) has increased yields, but not significantly so, and the higher level (M2) has depressed yield.

(c) The application of compost, at both levels (C1) and (C2) shows an increase in yield, the increase in the case of the lower level of application (C1) being almost significant.

TABLE 8

THREE-WAY TABLE ADJUSTED FOR BLOCK EFFECTS—MEAN OF 7 YEARS, 1942-48 CROP

Yields calculated as cwts. of clean coffee per acre (using actual out-turn)

	N0			N1			N2		
	C0	C1	C2	C0	C1	C2	C0	C1	C2
M0 ...	6·195	7·927	8·040	6·903	7·175	7·145	7·005	6·140	6·304
M1 ...	7·449	7·581	7·278	7·166	6·821	6·760	6·287	7·864	6·862
M2 ...	7·558	6·789	6·854	7·054	7·002	6·721	5·781	6·937	6·632

Standard Error ... ... ± 0·388

Significant Difference ... 1·097

Table 8 shows the effect of the treatments individually and in every combination. Compared with the nil treatment (M^0 C^0 N^0) :—

(a) Mulch alone shows significant increases in yield but there is no gain in applying the higher level (M^2) of Mulch.

(b) Compost alone shows significant increases in yield but there is no advantage derived from the application of compost at the higher level (C^2).

(c) Sulphate of Ammonia (N^1 and N^2) alone, yields more than the control (M^0 C^0 N^0) but not significantly so.

When the higher level of mulch (M^2) is applied in the presence of either levels of compost (C^1 or C^2) alone there is a significant decrease in yield. The addition of Compost in the presence of Sulphate of Ammonia alone or mulch alone makes virtually no difference in the yields, neither does the application of mulch in the presence of Sulphate of Ammonia or in the presence of Sulphate of Ammonia and compost together.

There appears to be no appreciable differences in the liquoring qualities of samples of coffee taken from the various plots in this experiment.

EXPERIMENT VI.—PLANTED 1941

This is a confounded $3 \times 3 \times 3$ factorial experiment in a 9×9 Latin Square, designed to determine the effects of three nitrogenous fertilizers applied at three different rates and at three different times of the year. The area is shaded with *Albizzia stipulata* and *Mæsopsis eminii* as semi-permanent shade trees; *Albizzia maranguensis* is the permanent shade tree. The trees are clonal material from unselected mother trees and are pruned on the single stem system. Although planted in 1941, the fertilizers could not be obtained until 1946; the experiment was therefore recorded as a uniformity trial for the period 1942-1945, and subsequent yields have been adjusted to those of 1945.

Treatments.

Quality.

1 Sulphate of Ammonia (20%)
2 Nitrochalk (15%)
3 Ammonium Nitrate (33%)

Dose in ozs. per tree	Sulphate of Ammonia	Nitrochalk	Ammonium Nitrate
1	3	4	1·87
2	6	8	3·75
3	9	12	5·60

Time of application.

1 in halves—mid-April (after 15″ rain) and mid-May.
2 all in May.
3 in halves—May and November.

The results for the year are given below in Tables 9-14, the yields being expressed as cwts. of clean coffee per acre.

TABLE 9

Summary of Results for Interaction of Quality and Dose

1948 Crop adjusted for 1945 values

Yields calculated as cwts. of clean coffee per acre

	Dose			
Quality	1	2	3	Mean
1	8·732	8·043	8·329	8·368
2	7·552	9·829	9·443	8·942
3	8·564	9·241	7·975	8·594
Mean	8·282	9·038	8·582	8·634

Average Standard Error—body of table ... ± 0·523
marginal means ... ± 0·523

TABLE 10

Summary of Results for Interaction of Quality and Time

1948 Crop adjusted for 1945 values

Yields calculated as cwts. of clean coffee per acre

	Time			
Quality	1	2	3	Mean
1	9·693	8·355	7·057	8·368
2	8·477	8·254	10·094	8·942
3	8·664	9·049	8·070	8·594
Mean	8·944	8·552	8·407	8·634

Average Standard Error—body of table ... ± 0·906
marginal means ... ± 0·523

TABLE 11

SUMMARY OF RESULTS FOR INTERACTION OF DOSE AND TIME

1948 Crop adjusted for 1945 values

Yields calculated as cwts. of clean coffee per acre

	TIME			
Dose	1	2	3	Mean
1	8·409	8·792	7·648	8·283
2	8·660	9·433	9·021	9·038
3	9·764	7·431	8·553	8·582
Mean	8·944	8·552	8·407	8·634

Average Standard Error—body of table ... ± 0·906

marginal means ... ± 0·523

None of the treatments has had any effect.

The mean yields for the two years 1947-48 are given in Tables 12 to 14 :—

TABLE 12

SUMMARY OF RESULTS FOR INTERACTION OF QUALITY AND DOSE

Mean yield of two years, 1947-48, adjusted for 1945 values

Yields calculated as cwts. of clean coffee per acre

	DOSE			
Quality	1	2	3	Mean
1	8·45	8·75	9·29	8·83
2	9·17	9·12	9·43	9·24
3	8·89	9·10	9·37	9·11
Mean	8·84	8·99	9·36	9·06

Average Standard Error—body of table ... ± 0·449

marginal means ... ± 0·259

TABLE 13

SUMMARY OF RESULTS FOR INTERACTION OF QUALITY AND TIME

Mean yield of two years, 1947-48, adjusted for 1945 values

Yields calculated as cwts. of clean coffee per acre

	TIME			
Quality	1	2	3	Mean
1	8·92	8·69	8·89	8·83
2	10·14	8·62	8·98	9·24
3	9·04	9·61	8·70	9·11
Mean	9·37	8·97	8·85	9·06

Average Standard Error—body of table ... ± 0·449

marginal means ... ± 0·259

TABLE 14

Summary of Results for Interaction of Dose and Time

Mean yield of two years, 1947-48, adjusted for 1945 values

Yields calculated as cwts. of clean coffee per acre

Dose	Time 1	2	3	Mean
1	8·92	9·17	8·40	8·83
2	8·82	9·08	9·08	8·99
3	10·35	8·66	9·08	9·36
Mean	9·37	8·97	8·85	9·06

Average Standard Error—body of table ... ± 0·449
marginal means ... ± 0·259

Here again, no differences have appeared and the treatments have been ineffective.

The time of application treatments are being modified in 1949.

Experiment IX.—Cultivation—Planted 1934

Laid out as a 5 × 5 latin square, the object of this experiment is to determine the effect of the various methods of cultivation. The experiment was planted with the seedling progeny of a planter's selection from a district remote from the Kilimanjaro-Meru coffee growing areas. It was originally grown on the single stem system without shade, but in 1944 it was converted to multiple stem. It is sited on sloping land, which had been previously terraced, with a western aspect.

Treatments.

A.—Forked jembe (forked hoe).
B.—Jembe (West Indian hoe).
C.—No cultivation.
D.—Envelope forking.
E.—Trenching.

Yearly yields for the eleven-year period 1938-48 are shown on page 38, and are expressed as cwts. of clean coffee per acre.

Summary of Results, 1938-1948

	* 1938	* 1939	* 1940	* 1941	* 1942	* 1943	* 1944	* 1945	* 1946	† 1947	† 1948	Mean of 11 years 1938–48	
Treatment :												Cwt.	Percentage
A. Forked hoe (forked jembe)	5·77	0·27	2·60	9·23	1·86	7·86	Converted to Multiple Stem	6·28	Crop Failed	24·17	1·52	5·34	112·0
B. West Indian hoe (jembe)	5·79	0·48	2·74	8·23	2·43	7·73		6·60		22·14	0·68	5·09	106·8
C. No cultivation	5·61	0·41	2·20	9·16	1·90	7·17		5·79		17·79	1·14	4·59	96·3
D. Envelope forked	4·55	0·35	1·67	7·32	1·63	5·26		5·29		21·47	1·28	4·48	94·0
E. Trenching	4·81	0·45	2·11	9·33	1·38	5·80		5·24		19·49	0·12	4·33	90·9
Mean	5·31	0·39	2·26	8·66	1·84	6·76		5·84		21·01	0·95	4·77	100·0
Standard error	—	—	0·34	0·33	0·10	0·12		0·62		1·689	0·268	0·378	7·9
Significant difference (P=·05) ...	—	—	1·05	—	—	—		—		—	0·825	—	—

*16 per cent Out-turn. †Actual Out-turn.

Over the period of eleven years there is no significant difference between the yields of the plots under the various treatments.

Experiment XIII.—Method of Pruning—Planted December, 1935

This experiment is laid out as 3 × 3 Latin Square, repeated three times in different parts of the Station. It is designed to compare three systems of pruning arabica coffee. Two of the replicates are lightly shaded with *Albizzia maranguensis*; the third is unshaded. The experiment is planted with seedling material.

Treatments.

s = Single stem.
M/3 = Multiple stem—3 suckers.
M/A = ,, ,, —Agobiada—3 suckers.

The yearly results for the eleven-year period 1938-48 are shown on page 40.

Yields in cwts., clean coffee per acre—based on actual out-turn

	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Mean of 11 years 1938-48	
												Cwt.	Percentage
Treatment :													
Single stem	FLY CROP	1·982	2·996	7·290	3·991	5·318	5·319	9·589	1·04	20·492	9·318	6·152	81·1
Multiple stem, 3 suckers ...		2·348	11·928	12·962	12·034	17·238	5·677	7·079	2·30	29·578	5·056	9·674	127·6
Agobiada, multiple stem, 3 suckers		0·407	6·607	6·370	7·494	13·079	4·992	8·028	0·90	17·329	10·987	6·926	91·3
Mean		1·579	7·177	8·874	7·840	11·878	5·329	8·232	1·41	22·467	8·454	7·584	100·0
Standard error		0·301	0·493	0·700	0·401	0·843	0·127	1·013	0·312	0·410	0·764	0·265	3·5
Significant difference (P=·05) ...		1·043	1·707	2·422	1·389	2·918	0·440	—	1·256	1·419	2·642	0·918	12·1

In 1948, the Agobiada system has significantly outyielded the ordinary multiple stem (3 suckers) system, as also has the single stem system. Over the eleven-year period, however the ordinary multiple stem system maintains its superiority. This difference is highly significant.

An analysis of the out-turn figures (clean to cherry) and also of the percentage of grades A and PB from the single and multiple stem trees shows that multiple stem trees give a slightly higher out-turn, single stem trees produce slightly more PB and that the percentage of A grade is the same from each.

Liquoring reports show no differences between the coffee produced under these three pruning systems.

Experiment XIVa.—Mulch—Planted 1940

Laid out as a 5×5 latin square, with split plots to show the effects of sulphate of ammonia, this experiment is designed to determine the effects on yield of banana trash, guinea grass (*Panicum maximum*) and elephant grass (*Pennisetum purpureum*) applied as mulches, compost made from an equivalent amount of elephant grass, and clean cultivation. The trees are clonal material from unselected mother trees and are pruned on the single stem system. The area is sparsely shaded with *Albizzia maranguensis* as the permanent shade tree.

Treatments.

A.—Control—routine clean cultivation.
B.—Banana trash (80 lb. per tree).
C.—Elephant grass (,, ,, ,,).
D.—Guinea grass (,, ,, ,,).
E.—Compost (,, ,, ,,).

Sulphate of Ammonia (Sub-plots).

1941-2—2 oz. per tree.
1943-5—4 ,, ,, ,,
1946-8—8 ,, ,, ,,

As in Experiment V, the mulches (dried material) are applied after the long rains; the compost is applied just before the long rains and is lightly forked in; the Sulphate of Ammonia is applied after approximately fifteen inches of rain has fallen.

The yearly results and the mean for seven-year period 1942-1948 are given in Appendix III, the yields being calculated as cwts. of clean coffee per acre.

CLONES.

The yearly yields for the four clones in this experiment are shown in Table 17 together wih the mean for the seven-year period 1942-48.

TABLE 17

Mean yields for Clones—calculated as cwts. of clean coffee per acre

Clone	1942	1943	1944	1945	1946	1947	1948	Mean 1942-48 Cwt.	Mean 1942-48 Percentage
KIL 50	1·45	5·73	2·57	1·01	2·33	12·05	14·96	5·73	92·1
KIL 98	1·57	6·82	2·86	1·26	2·81	13·56	16·43	6·48	104·1
KIL 48	1·50	6·14	2·80	1·15	2·86	13·53	15·57	6·22	100·1
KIL 10	1·62	7·88	2·73	1·47	2·41	13·80	15·22	6·45	103·7
Mean	1·54	6·64	2·74	1·23	2·60	13·23	15·55	6·22	100·0
Standard Error ...	0·124	0·386	0·160	0·166	0·186	0·590	0·934	0·190	3·1
Significant Difference (P = ·05). ...	—	1·142	—	—	—	—	—	0·561	9·0

Only in one year (1943) has the difference between the clones been significant, but throughout the period KIL 50 has given a lower yield than the remaining three. This is emphasized in the analysis of the total for the period, where KIL 50 yields significantly (P = ·05) less than the other clones. There is virtually no difference between the remaining clones.

INTERACTIONS.

The adjusted yields for interaction of Irrigation and Mulch for 1948 and the mean yields over the seven-year period 1942-48 are given below in Tables 18 and 19 respectively.

TABLE 18

Adjusted yields for Interaction of Irrigation and Mulch, 1948 Crop

Calculated as cwts. of clean coffee per acre

Mulch	Irrigation 0 Cwt. per acre	%	1 Cwt. per acre	%	2 Cwt. per acre	%	3 Cwt. per acre	%	Mean Cwt. per acre	%
0	15·467	99·5	12·333	79·3	11·064	71·2	8·392	54·0	11·814	76·0
1	20·805	133·8	16·629	107·0	14·292	91·9	14·253	91·7	16·494	106·1
2	21·140	136·0	16·968	109·2	16·254	104·6	15·370	98·9	17·433	112·1
3	17·290	111·2	15·750	101·3	17·320	111·4	15·394	99·0	16·438	105·7
Mean ...	18·675	120·1	15·420	99·2	14·733	94·8	13·352	85·9	15·545	100·0

	Cwt. per acre	%
Standard Error for Marginal means	± 0·934 ...	6·0
Significant difference for Marginal means ...	± 2·764 ...	17·8
Standard Error of Entries in body of table ...	± 1·868 ...	12·0

TABLE 19

Adjusted yields for Interaction of Irrigation and Mulch

Mean yield of seven years, 1942-1948 (Actual Out-turn)

Calculated as cwts. of clean coffee per acre

Mulch	Irrigation 0 Cwt. per acre	%	1 Cwt. per acre	%	2 Cwt. per acre	%	3 Cwt. per acre	%	Mean Cwt. per acre	%
0	3·216	51·7	5·413	87·1	5·594	90·0	4·713	75·8	4·734	76·1
1	5·884	94·6	7·521	121·0	6·952	111·8	6·917	111·2	6·818	109·6
2	5·808	93·4	7·083	113·9	6·858	110·3	7·275	117·0	6·756	108·7
3	5·157	82·9	7·278	117·0	6·980	112·3	6·836	109·9	6·563	105·5
Mean ...	5·017	80·7	6·824	109·7	6·596	106·1	6·435	103·5	6·218	100·0

	Cwt. per acre	%
Standard Error for Marginal Means	± ·190 ...	3·1
Significant difference for Marginal Means ...	± ·561 ...	9·0
Standard Error of Entries in body of table ...	± ·379 ...	6·1

The interaction mulch-irrigation is not significant. The increase in yield shown by the plots receiving the lower level of mulch together with the lower level of irrigation, i.e., M^1,-I^1 plots over those receiving the lower level of mulch alone (M^1) or the lower level of irrigation alone (I^1), is a result of the effects of mulch and irrigation independently, i.e., the effects are additive.

Samples from all the treatments, and combinations of treatments, were submitted for liquoring. No appreciable differences occurred in the classifications allotted to the various samples.

STATEMENT OF EXPENDITURE FOR THE PERIOD 1ST JANUARY TO 31ST DECEMBER, 1948

V.—AGRICULTURE.

I.—Personal Emoluments

Item No.		Provision Shs.	Cts.		Expenditur. Shs.	Ctse
30.	Clerks (L.C.S.)	6,360	00	...	6,035	00
32.	Recorders (L.C.S.)	14,760	00	...	8,678	31
34.	Artisans (L.C.S.)	6,880	00	...	7,060	00
35.	Instructors (L.C.S.)	3,040	00	...	1,561	00
38.	Laboratory Assistants (L.C.S.)	2,810	00	...	113	67
39.	Overseers (L.C.S.)	870	00	...	894	00
41.	Motor Drivers (L.C.S.)	870	00	...	864	00
42.	Messengers	600	00	...	872	00
		36,180	00	...	26,077	98

II.—Other Charges

43.	House Allowance (as and when required)	—		...	19	35
44.	Transport and Travelling	8,500	00	...	7,529	85
45.	Maintenance and Running of Motor Vehicles	4,250	00	...	4,090	54
46.	Books of Reference	1,400	00	...	461	66*
47.	Contingencies	100	00	...	56	80
48.	Office and General	600	00	...	500	86
60.	Upkeep of and Minor Improvements to Agricultural Stations	2,500	00	...	2,811	87
62.	Upkeep of Coffee Research Station :					
	(a) Labour			...	52,504	52
	(b) Field Experiments off Station			...	1,447	95
	(c) Maintenance of Power, Light and Gas			...	3,559	02
	(d) Maintenance of Water Supply			...	485	50
	(e) Upkeep of Coffee Factory			...	3,098	00
	(f) Upkeep of Stock	116,340	00	...	4,993	70
	(g) Equipment and Materials			...	19,908	61*
	(h) Trials of Clonal Coffee Selection			...	571	15
	(i) Miscellaneous			...	109	00
	(j) Purchase of Machinery for Coffee Research Station			...	9,383	48
	(k) Maintenance of Farm Machinery			...	935	40
	(l) Work on Lyamungu Coffee Estate			...	14,583	99
	(m) Soil Conservation and Stream banks			...	2,858	25
		†133,690	00		129,909	50
	*Outstanding Crown Agents Indents, say	—		...	6,000	00
	Grand Total	133,690	00	...	135,909	50

†NOTE.—Authority to overspend the allocation was given in Director of Agriculture's letter No. 1297/8485 of 18th August, 1948.

II.—Other Charges—(contd.)

	Provision		Expenditure	
	Shs.	Cts.	Shs.	Cts.
Special Funds—Coffee Board	11,500	00	11,353	58
23. Miscellaneous Services—20 Passages	—		162	00
23. Miscellaneous Services—21 Postages	—		99	05
83. Contribution to the Agricultural Show, Northern Province	4,000	00	2,295	33
34. Sub-item 2, Temporary Bonus	—		8,531	66
Salary Award—Reserved (Ungraded Staff)	—		1,025	00
31. Public Works Recurrent—1, Maintenance of and Minor Improvements to Public Buildings	5,600	00	4,027	48
32. Public Works Recurrent—51, Minor Works :				
(a) Lyamungu Plant Pathology Laboratory—Dark Room	1,000	00	—	
(b) Coffee Research and Experimental Station, Lyamungu—Lavatory for Africans	1,200	00	517	95
35. Subventions—41, Contribution to Labour Utilization Board	3,750	00	2,423	25

MONTHLY RAINFALL FROM SEPTEMBER 1937 TO END OF AUGUST 1948

(in inches)

	September 1937 to end of August 1938	September 1938 to end of August 1939	September 1939 to end of August 1940	September 1940 to end of August 1941	September 1941 to end of August 1942	September 1942 to end of August 1943	September 1943 to end of August 1944	September 1944 to end of August 1945	September 1945 to end of August 1946	September 1946 to end of August 1947	September 1947 to end of August 1948
September	1·03	0·17	1·61	0·33	2·76	0·11	0·49	2·42	0·20	7·34	1·23
October	4·35	2·16	0·08	1·03	0·09	0·42	0·17	3·15	0·05	4·71	1·27
November	3·91	2·57	0·57	0·90	4·47	3·60	2·00	3·10	4·66	1·13	0·93
December	1·64	1·02	0·32	1·07	9·72	1·75	0·32	5·14	0·30	2·19	1·31
January	0·52	0·22	2·83	1·23	1·59	0·07	1·02	1·72	0·02	2·01	0·46
February	2·43	0·41	5·27	1·91	0·38	2·61	1·69	1·39	1·14	0·72	0·71
March	12·42	4·57	4·12	2·38	15·02	1·32	5·82	4·85	0·57	3·37	2·72
April	10·79	26·18	21·63	15·92	37·07	7·95	30·04	15·19	16·90	28·45	14·50
May	19·44	25·31	12·04	10·24	19·43	19·46	11·97	21·34	22·74	25·73	15·56
June	2·61	8·74	2·68	5·09	4·54	4·06	4·65	3·45	2·54	10·97	2·93
July	1·92	0·77	2·04	0·76	2·38	4·42	2·21	3·15	0·59	1·43	1·53
August	0·67	0·54	2·58	2·10	1·22	0·37	1·43	1·33	1·03	1·38	0·44
Total (in ins.) ...	61·73	72·66	55·77	42·96	98·67	46·14	61·81	66·23	50·74	89·43	43·59

SUMMARY OF RESULTS FOR INDIVIDUAL YEARS FROM 1942-1948

Yields calculated as cwts. of clean coffee per acre

N1 = Plots to which Sulphate of Ammonia applied.

N0 = Plots to which no Sulphate of Ammonia applied.

	1942			1943			*1944			*1945			*1946			*1947			1948			Summary of 7 years 1942-1948					
	Main plots	Sub-plots		Main plots	Sub-plots		Main plots	Sub-plots		Main plots	Sub-plots		Main plots	Sub-plots		Main plots	Sub-plots		Main plots	Sub-plots		Main plots		Sub-Plots			
		N1	N0		N1	N0		N1	N0		N1	N0		N1	N0		N1	N0		N1	N0		Per-centages	N1	Per-centages	N0	Per-centages
Treatments:																											
A. Nil	1·73	1·80	1·66	4·86	4·68	5·04	0·05	0·04	0·07	10·63	11·82	9·43	0·14	0·06	0·23	12·92	11·50	14·35	6·65	5·92	6·38	5·24	93·4	5·21	92·9	5·27	93·9
B. Banana mulch (80 lb. per tree) ...	2·09	1·87	2·31	4·46	4·09	4·82	0·70	0·36	0·84	11·34	11·90	10·77	0·63	0·36	0·90	14·64	13·30	15·97	8·17	8·33	8·02	5·95	105·9	5·73	102·0	6·17	109·9
C. Elephant Grass (80 lb. per tree) ...	1·77	1·73	1·80	4·61	4·55	4·67	0·37	0·23	0·50	11·95	11·50	12·40	0·16	0·13	0·19	14·20	14·76	13·64	6·64	5·78	7·49	5·63	100·2	5·49	97·7	5·77	102·7
D. Guinea Grass (80 lb. per tree) ..	2·05	1·90	2·21	5·02	4·18	5·87	0·94	0·35	1·53	9·83	11·25	8·40	0·59	0·35	0·83	16·02	16·89	15·14	7·22	6·70	7·73	5·89	104·9	5·90	105·1	5·88	104·7
E. Compost (1 debe per tree) ...	1·26	1·22	1·29	4·93	4·23	5·63	0·08	0·06	0·10	10·63	10·75	10·52	0·03	0·03	0·44	15·11	17·03	13·18	5·74	4·73	6·75	5·37	95·6	5·40	96·2	5·33	94·9
Mean	1·78	1·70	1·85	4·78	4·34	5·21	0·43	0·25	0·61	10·87	11·44	10·30	0·31	0·19	0·44	14·58	14·70	14·46	6·88	6·49	7·27	5·61	100·0	5·55	98·8	5·68	101·2
Standard error	0·052	0·009	0·009	0·22	0·13	0·13	0·093	0·329	0·329	0·808	0·409	0·409	0·081	0·070	0·070	1·216	1·229	1·229	0·749	0·740	0·740	0·331	5·9	0·286	5·1	0·286	5·1
Significant difference (P = ·05) ...	—	—	—	—	0·36	0·36	0·287	—	—	—	1·208	1·208	0·246	0·207	0·207	—	3·627	3·627	—	—	—	—	—	—	—	—	—

*Results worked out on actual out-turn basis. Remainder on 16%.